

REVISION OF *NOTHOFAGUS* IN NEW CALEDONIA

by C. G. G. J. VAN STEENIS

SUMMARY: Essentially a revision of the genus *Nothofagus* in New Caledonia. Five species are recognized, keyed out and described. Specimens are enumerated with the ecological notes pertaining to them. General considerations precede the revision, containing notes on ecology, mutual affinities, geographical importance of the range of *Nothofagus*, its fossils and their consequence: the theory on the origin of *Fagaceae* within the Yunnan—Queensland matrix area in Cretaceous time.

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As early as 1869 BALANSA collected two species in New Caledonia which were described by BAILLON in 1873 and assigned to the *Euphorbiaceae*, under the generic name *Trisyngyne*. As late as 1951 it became known, through the combined exploration by Prof. Dr. A. GUILLAUMIN, Dr. H. HÜRLIMANN and Dr. G. BAUMANN-BODENHEIM that this genus is not at all rare in New Caledonia but occurs sometimes even in a dominating position in the forest, and that more species of it occur. An obviously preliminary succinct account of these results was given by the latter author, who recognized five species, among which three were new.

Though it had then become clear that *Trisyngyne* belongs to *Fagaceae*, and is closely allied to *Nothofagus*, BAUMANN-BODENHEIM maintained its distinctness from *Nothofagus*, without sufficiently argumenting this view.

In 1939 it had appeared that *Nothofagus* occurred in New Guinea which I elaborated in a comprehensive revision of the genus *Nothofagus*, coming to the conclusion (J. Arn. Arb. 34 : 301-374. 1953) that they should be accommodated in *Nothofagus* as a separate subsection *Bipartitae* of typical *Nothofagus* pollen, the *brassii* subtype. This was first announced *Trisyngyne* could not be upheld as a separate genus and I transferred the New Caledonian species to *Nothofagus* (J. Arn. Arb. 35 : 266-267. 1954).

This opinion was shared by the palynologists, as the pollen of the New Caledonian and New Guinean species belongs to a distinct subtype of typical *Nothofagus* pollen, the *brassii* subtype. This was first announced by Miss COOKSON in a preliminary announcement (Nature 170 : 127. 1952) and later elaborated by her and PIKE (Austr. J. Bot. 3 : 197-206. 1955) in which study they examined pollen from both New Guinean and

New Caledonian species and found them to belong exactly to the same *brassii* subtype.

This *brassii* subtype appeared to have been already described in the fossil state from Australia and New Zealand and was assumed to belong to extinct *Nothofagus* species. Later research revealed that this *brassii* subtype of pollen is very widely distributed as fossil pollen, even as far as Seymour Island and Fuegia and, moreover, that it is one of the two oldest *Nothofagus* pollen types known, dating back at least to the Upper Cretaceous.

The morphological and palynological conclusion to the congenerity of *Trisyngyne* and *Nothofagus* was furthermore sustained by the wood anatomy which was studied by DADSWELL and INGLE (Austr. J. Bot. 2 : 141-153, 1954) who concluded that "evidence from the anatomy of the wood supports the botanical grouping of the New Guinea material into a distinct subsection of *Nothofagus*", and furthermore "that this evidence is not inconsistent with the theory that the New Guinea species are living relics of a former more widely distributed genus, the temperate group being derivative from this." They also noted that the New Caledonian material was anatomically similar to that of the New Guinea species, although not identical with them. From New Caledonia they had only twig material at their disposal. Later they had examined wood from three New Caledonian species, and in a letter dated Aug. 26, 1968, Mr. INGLE confirmed that he could not see any distinction in the secondary wood between the New Guinean and New Caledonian species.

Summarizing the taxonomy, there seems to be no doubt that *Trisyngyne* must be reduced to *Nothofagus* subsection *Bipartitae*.

Morphologically the New Caledonian species are at once distinguishable from those of New Guinea by the fact that the leaves are not arranged distichously along the twigs but spirally. It is noteworthy but cannot affect their generic or even infrageneric status. Differences in phyllotaxis in *Fagaceae* occur elsewhere, notably in *Trigonobalanus* of which one species has spiral leaves and the other leaves in whorls of three. A second point is that all New Caledonian species have coarse foliage and cupules but only very few in New Guinea, and that the nuts of the New Caledonian species are much larger than those of all of the New Guinean species.

There are several reasons for framing this new revision of the New Caledonian species, the first being that BAUMANN-BODENHEIM's preliminary descriptions were very meagre, which was in no mean degree due to the scarcity of the material in the fifties. Even now the completely mature cupules and nuts are not known of all species and male flowers have not been collected of two species. Furthermore, several important characters were not mentioned by him, notably the deviating phyllotaxis of the New Caledonian species. Finally, specific delimitation had to be tested with the abundant material collected since 1951, especially for the use of foresters and ecologists studying the ecology of the species and their role in New Caledonian vegetation, including the life cycle, growth rate, germination and regeneration.

For field ecologists *Nothofagus* is not difficult to spot as it is rather easily distinguishable and cannot be mistaken even in the vegetative state by the occurrence of perular buds and large peltate stipules, both bud-scales and stipules possessing a range of colleters at their insertion; furthermore their leaves are gland-dotted beneath; both these glands and colleters exude a resinous wax when the flush is coming out and making this shining and sticky.

The growth mode is flush-wise and the thin young leaf is reddish. At that time also the flowers appear, the red males in pseudo-glomerules of triads (strictly on short-shoots), below the females.

At mature size New Caledonian species are comely trees, but seldom exceed 20 m in height, in contrast with New Guinean species which attain c. 40-45 m in height when full grown.

An other important point for the ecologists is the specific distinction, as each species must have its own autecology and its evaluation must be based on correct specific identification.

As far as I know only few papers deal as yet with the ecology of the New Caledonian species, which within subsection *Bipartitae* show an important extension of the ecological range of the section in that some occur down almost as low as sea-level.

BAUMANN-BODENHEIM published on this interesting feature a succinct note (Geobot. Forsch. Inst. Rübel Zürich für 1955 : 64-74), based on data then known to him.

HÜRLIMANN (Proc. 9th Pac. Sci. Congr. Bangkok 1957, 4. Bot. : 89-94. 1962) published a sort of analysis of the structure of *N. codonandra* forest plots and plants associated in these, with due attention to strata in this forest, age classes of the *Nothofagus*, and its dominance in the canopy, the latter a rather rare phenomenon in tropical forests which are usually of a very mixed character. *Nothofagus* grows in New Caledonia mainly on serpentine parent rock areas.

DAWSON (Tuatara 14 : 1-7. 1966) recorded his ecological experience with three New Caledonian species; on Col des Roussettes he found a species which he obviously referred to *N. balansae*, but which I believe is *N. aequilateralis*, of which he studied an almost pure ridge crest stand, noting seedlings abundantly on clay banks edging the road. On the Montagne des Sources he found scattered patches randomly dispersed of *N. codonandra* in the forest without preference for ridges, confirming a personal observation from Mr. SCHMID who found the same species mostly on side slopes of ridges. He found *N. codonandra* also as scattered river margin trees along the Rivière Bleue which originates on this mountain complex. He recorded a third species casually, which I believe was *N. balansae*. He mentioned also the interesting periodicity in flowering observed by Mr. CORBASSON to represent a 7 year cycle (1950, 1957, 1964). He concluded that it appeared to him that "where the climate is suitable for rain forest, and where there is no special edaphic factor such as serpentine parent rock, *Nothofagus* tends to be restricted to situations where the soil is poor, particularly along ridge crests."

He finished with a more generalized conclusion on the genus as a whole in saying that " At higher altitudes and latitudes, where climates are less favourable or unfavourable for rain forest *Nothofagus* may then form continuous and much more extensive forests. " The latter conclusion I cannot share as far as the factor altitude is concerned as in New Guinea *Nothofagus* may occur dominant or co-dominant in rain-forest sites not correlated as far as we know with specialized soil or parent rock conditions.

For the convenience of botanists and plant-ecologists in New Caledonia who have not access to all material I have studied, I have cited the localities with such field data as seem useful for later ecological studies on the occurrence of the genus, notably altitude, parent rock, and date of flowering. Unfortunately a number of collections are accompanied with cupules gathered on the ground below the tree; these have not been cited when withered and too old to be of value for indicating the ripening season.

As to specific delimitation and the number of species which occur in New Caledonia, I remark that at first sight they look very distinct. I could rather easily refer all the material at hand to the five species distinguished by BAUMANN-BODENHEIM, not confirming the rumours of new species. The framing of a key was less easy, however, as on closer view the precise variability in detail appeared greater than expected. My impression is further that the species are more closely allied mutually than their outward distinctness would induce to think.

The key I have designed is based on vegetative characters of material collected from mature trees. It remains possible that the flowers, nuts or cupules may yield additional characters but the material at hand is insufficient to define such characters.

Some show also some likeness to Papuan species, leaving apart the difference between all New Caledonian species and Papuan ones, the phyllotaxis and larger nuts: *N. discoidea* resembles *N. perryi* from New Guinea but has only one female flower and hence one nut per cupule, and *N. aequilateralis* resembles in leaf *N. starkenborghii* from New Guinea. Obviously affinities are more or less reticulate in the subsection, and reduction has appeared 'parallel', that is independently in several ancestral lineages.

As a whole the small New Caledonian set of species is morphologically less derived than the Papuan set of 13 species. All New Caledonian species save one have the flowers of both sexes in triads and possess multi-lamellar cupules. In the New Guinean set there are nine species with solitary female flowers and four with solitary male flowers, and besides many species show oligolamellar cupules, and some even a complete absence of a cupule.

One might be induced then to expect fossils of *Nothofagus* to occur in New Caledonia, like they are found in New Guinea. In contrast with Australia, where they are found onwards of the Upper Cretaceous, fossil pollen of *Nothofagus* has in New Guinea up till now only been located from the Upper Miocene until the Recent. And none has been reported

from New Caledonia. My firm conviction is that whereas *Nothofagus* must have a long history behind it in both islands, future research will reveal old fossil pollen in both Papua and New Caledonia, both from the Tertiary and possibly even from the Upper Cretaceous.

I derive this perspective from the following consideration. From the plant-taxonomical standpoint I regard *Nothofagus* (Blumea 19 : 65-98. 1971) as a key genus for plantgeography because its ample fossil and recent occurrence make the family *Fagaceae* a distinct bi-hemisphere family. In the area between Yunnan and Queensland almost the entire gene-pool of the living representatives of the family is present (7 genera), with even an endemic palaeoploid genus (*Trigonobalanus*). This centre I regard as a primitive centre, an idea partly induced by the fact that Upper Cretaceous fossils have been found in bipolar situations (Greenland and Antarctica), partly because the living representatives are almost restricted to ancient geological shields. Whereas both New Guinea and New Caledonia are situated in the immediate vicinity of this old centre, which harboured the primary *Fagaceous* matrix or even make part of it, it is most likely that *Nothofagus* occurred very early in the sites where these islands occur today. Besides, in both islands *Nothofagus* is associated with *Araucaria*, in fact the recent distribution of *Araucaria* occupies an area which is homologous to that of *Nothofagus*.

Critics may question then why *Nothofagus* is not wider spread in Malesia beyond and why *Araucaria* occurs on the Brazilian shield where *Nothofagus* has never been found. Such questions cannot be answered, but such negative arguments can on the other hand, I feel, not obscure sound theory. One is tempted to expect fossil Tertiary pollen of *Nothofagus* both in Malesia and on the Brazilian shield.

I am greatly indebted to Professor LEROY, directeur du Laboratoire de Phanérogamie, Paris, who put the material at my disposal which made it possible to draw this revision.

KEY TO THE SPECIES

1. Leaves obovate-oblong, tapering from a broad base to an acute or subacute apex, distinctly crenate, each nerve ending in a crenation, $7\frac{1}{2}$ - $12\frac{1}{2}$ by $2\frac{1}{2}$ -5 cm. Nut solitary..... 5. *N. discoidea*
- 1'. Leaves of other shape, not acute or acuminate. Nuts 3 per cupule.
 2. Leaves rather narrow (index $2\frac{1}{2}$ -3), widest in the middle, narrowing gradually to both ends, at apex not broadly rounded, flat, entire, 4-10 by $1\frac{1}{4}$ - $3\frac{1}{2}$ cm..... 1. *N. aequilateralis*
 - 2'. Leaves of other shape, if narrow either bullate or the apex broadly rounded or stunted and with a conspicuous notch, or the apical part crenate.
 3. Leaves clearly bullate, with conspicuously recurved margin and on the upper surface the nerves depressed and very prominent beneath, coarse, with very thick petiole..... 2. *N. codonandra*
 - 3'. Leaves flat, nerves not or hardly depressed above.
 4. Leaves very hard and thick-coriaceous, with very thick petiole, the upper surface smooth with practically invisible vein-netting, 5-14 by $2\frac{1}{2}$ -7 cm..... 3. *N. baumanniae*

- 4'. Leaves rather thin-coriaceous, with slender petiole, the fine-tessellate vein-net on the upper surface clearly visible, obovate-oblong (rarely elliptic), $4\frac{1}{2}$ -8 by 2-4 cm..... 4. *N. balansae*

1. *Nothofagus aequilateralis* (B.-B.) Steen.

J. Arn. Arb. 35 : 266 (1954).

— *Trisyngne aequilateralis* BAUMANN-BODENHEIM, Bull. Mus. Hist. Nat. Paris, ser. 2, 25 : 421 (1953).

— ?*N. balansae* (non al.) DAWSON, Tuatara 14 : 2, fig. 1c (1966).

Tree 8-20 m high, c. 20-45 cm diameter. Leaves elliptic-oblong to almost elliptic-lanceolate, widest in the middle, attenuate to both ends, with blunt apex, coriaceous, entire, 4-10 by $1\frac{1}{4}$ - $3\frac{1}{2}$ cm; upper surface with fine tessellate venation but not prominent, ridge on midrib only in the lower third, beneath reticulations little prominent; nerves 11-15 pairs, arching within the margin but not running to it, prominent beneath; petiole 7-10 mm. ♂ Flowers red, in 2-5 mm peduncled triads, perianth 5-6 mm long, on a very short hypanthium; stamens c. 10-15. ♀ Flowers 3. Cupule sessile, not very woody, with 4-5 lamellae, the halves c. (10—) 13-14 by (8-)9-10 mm. Nuts ovate to broad-elliptic, with a narrowly winged margin, protruding from the cupule, 10-14 by (8-)11-13 mm.

TYPE : *Baumann-Bodenheim 15273*.

Col des Rousseltes, traversée piste de Houailou, entre Borameyi et Capreopa, 600 m, fr., *Blanchon 991*; ditto, 500 m, ♂ March, *McKee 14530* (coll. H. Gay); ditto, au pied du Mt Aouli, 600 m, sur schistes, forêt dense, fr. Sept., *Blanchon 991*. — Crête entre le Grand Lac et la petite Yaté, 400 m, terrain serpentineux, fr. Nov., *McKee 22869*. — Plaine des Lacs, nord du Grand Lac, 200 m, ♂ Jan., *Veillon 1920*; ditto, 300 m, dominant, sol ferrallitique gravillonnaire, fr. Dec., *Jaffré 349*; ditto, 250 m, sur périclites, *Dawson (18/12/70)*; ditto, vallée de la Yaté, Rivière Blanche, 200 m, young fr. Aug., *Abbe & Corbasson 12188*; ditto, forêt humide, *McKee 21618*. — Mois de Mai, *Baumann-Bodenheim 15273, 15275, 15276*. — Mt des Sources, à cote 570, *Corbasson 218, 221*; ditto, 500 m, terrain serpentineux, fr. Jan., peuplements nombreux dominant par endroits la forêt, *McKee 23126, 23127* (juv.); ditto, 480 m, headwaters of Rivière du Casse Cou entre Pic Buse et Casse Cou, *Abbe & Corbasson 12201*; ditto, 600 m, associé avec *Araucaria bernieri*, *Agathis lanceolata*, *Podocarpus ferruginoides*, *Ingle 1.79*, Route des Sources, petit peuplement de chaque côté entre côtes 470 et 495, fr. June, *Corbasson 215*. — Haute Neaoua : Ouen Sieu, 500-600 m, forêt humide sur schistes dominé par *Nothofagus*, vern. « faux galeac », *McKee 21595*.

Vallée du Creek Pernod, 200-250 m, sur périclites, *M. Schmid 333*. — Bon Secours, baie des Pirogues (forêt Pérignon), fr. June, *Corbasson 211*. — Mt Boulinda, pente nord, 1150-1300 m, terrain serpentineux, *McKee 17327*.

ECOLOGICAL SUMMARY: Parent rock schistes, sol ferrallitique, périclites, serpentine. ♂ Flowers Jan., March. Fruits June, Sept.-Dec. Altitude: 200-600, once at 1 100-1 300 m.

NOTES : Juvenile, sterile specimens have of course the largest leaves, up to 11-12 by 4-5 cm. Some specimens (*Jaffré 349, Veillon 1920, McKee 22869*) have small leaves, 3-5 by $1\frac{1}{4}$ -2 cm and small thinnish cupules but it is not clear whether the latter are mature. In leaf-size there is a gradual series from the small ones to the larger.

The leaves of seedlings as represented by *McKee 23127* are almost indistinguishable from those of *N. balansae*, acute-acuminate, lanceolate, with a few minute teeth; the collector must be assumed to be correct to associate them with the mature tree in the field; this cannot be ascertained from herbarium material. If these two species occur together such association may prove impossible.

2. *Nothofagus codonandra* (Baill.) Steen.

J. Arn. Arb. 35 : 266 (1954); DAWSON, Tuatara 14 : 2, fig. 1a-c (1966).

— *Trisyngyne codonandra* BAILL., *Adansonia* 11 : 136 (1873); BAUMANN-BODENHEIM, Bull. Mus. Hist. Nat. Paris, ser. 2, 25 : 420 (1953).

Tree, 8-20 m high, up to 75 cm diameter. Leaves oblong-elliptic to obovate, usually bullate with strongly recurved margin and the nerves depressed above, entire, 7-12 1/2 by 3-6 cm; upper surface fine-tessellate but not prominently so; nerves 10-15 pairs, strongly prominent beneath, distinctly but shallowly sunken above, upper ones running to the minute crenations at the margin, no ridge on the midrib above except at the transition to the petiole; petiole 5-14 mm, very thick. ♂ Flowers red, 5-15 mm peduncled, the triads in pseudo-glomerules, hypanthium c. 2-3 mm, perianth 5-6 mm; stamens c. 15. ♀ Flowers 3. Cupule sessile to subsessile (peduncle up to 5 mm), thick, with 6-7 lamellae, finally very woody, the halves 16-30 by 12-20 mm. Nuts broad-ovate to obovate-obtriangular, narrowly winged, 15-20 by 13-18 mm.

SYNTYPES : *Balansa* 2749 ♂, 3557.

Moindip, 400 m, grégaire en forêt vallicole sur grauwaacke, fr. June, *Veillon 1955*, — Haute Tiwaka, contrefort est du Tchinguou, 800 m, maquis sur terrain serpentineux, ♂ Jan., *McKee 20104*. — Mt Humboldt, 800 m, ♂ Febr., *Balansa 3557*. — Pic Buse, *Baumann-Bodenheim 16073*. — Entre Pic Camboui et la Dent de Saint-Vincent, 1 100-1 200 m, terrain rocheux serpentineux, dominant par endroits, *McKee 23061*. — Mt Do, plateau sommital, 950-1 020 m, forêt d'*Araucaria-Nothofagus*, terrain serpentineux, arbre dominant, fr. Oct., *McKee 21086*; ditto, *McKee 15981*; ditto, vers 1 000 m, sur péridotites, fr. Nov., *Veillon 958*. — Mt Koghi, L. Lavoix in J. P. Blanchon 1631 ♂, anno 1963. — Mt Koungouhaou Nord, 1 000-1 100 m, reste de forêt sur terrain serpentineux, *McKee 17968*, 17969 (juv.). — Mt Mou, 900 m, *Baumann-Bodenheim 14910* (juv.); ditto, 750 m, *Baumann-Bodenheim 1642*, 1743, 14843; ditto, 900 m, *Baumann-Bodenheim 14907*, 14908; ditto, 1 100 m, ♂ April, *Balansa 2749*. — Rivière Bleue, 200 m, forêt galerie, *McKee 12406*; ditto, 150 m, *Bernardi 9340*; ditto, *Aubréville & Heine 181*; ditto, young ♀, *Aubréville & Heine 149*; ditto, fr. June, *Corbasson 112*; ditto, 150-250 m, pentes rocheuses, commun près de la rivière, fr. Sept., *McKee 17571*; Vallée de la Yaté, au Pont Germain, *Abbe & Corbasson 12189*. — Route de Mt des Sources, 500 m, terrain serpentineux, fr. Jan., *McKee 23129*; ditto, 600 m, forêt en ravin, *Thorne 28685*; ditto, 1 000 m, dominant sur crête sommitale, *McKee 5339*; ditto, à cote 700, *Corbasson 220*; ditto, versant Dumbéa, à cote 650, fr. June, *Corbasson 219*; crête sommitale, 950 m, ♂ April, *McKee 16689* (coll. M. Boulet).

ECOLOGICAL SUMMARY: Parent rock grauwaacke, serpentine, péridotite, several times in gallery or riverine sites. ♂ Flowers Jan.-April. Fruits Jan., June, Sept.-Nov. Altitude : 150-1 200 m.

NOTES: As usual in the genus leaves of juvenile specimens are very large, here up to 18 by 8 cm, and less bullate than in mature trees.

The very thick petiole and base of midrib remind of *N. baumannii* which seems to me nearest allied.

The only seedling in the herbarium is *Baumann-Bodenheim 14910*; nerves and midrib elevated, and undeterminable, hence the identification rest with the responsibility of the collector.

3. *Nothofagus baumanniae* (B.-B.) Steen.

J. Arn. Arb. 35 : 266 (1954).

— *Trisyngyne baumanniae* BAUMANN-BODENHEIM, Bull. Mus. Hist. Nat. Paris, ser. 2, 25 : 420 (1953).

Tree, 10-30 m high. Leaves broad-elliptic oblong to somewhat obovate, hard coriaceous, at the base truncate to subcordate, or abruptly short-attenuate, \pm flat, entire or rarely \pm undulate, 5-14 by 2 $\frac{1}{2}$ -7 cm, the upper surface very smooth, no nerves or veins visible, underneath the reticulate veins thinly and the nerves more strongly prominent; nerves 11-13 pairs running to the crenations of the edge; midrib in the lower part wide and in the lower fourth part prominent towards the petiole; petiole very thick, 5-15 mm. ♂ Flowers: perianth 4-6 mm long (sec. B.-B.). ♀ Flowers 3 per cupule. Cupule almost sessile, with 5-8 lamellae, woody, 2 $\frac{1}{2}$ -4 cm long. Nuts broadly ovate, 20-25 by 18-20 mm.

TYPE : *Baumann-Bodenheim 11277*.

Mt Mou, 1 150-1 200 m, fr. Oct., *Baumann-Bodenheim 15628*; ditto, 1 150 m, *Baumann-Bodenheim 11243*, (fr. March) *11277, 11295, 11703, 15596, 15600, 15606, 15626, 15700*; ditto, 1 000 m, *Dawson 107*; ditto, forêt sommitale sur péridotites, fr. Jan., *M. Schmid 2645*.

ECOLOGICAL SUMMARY: Parent rock peridotite. ♂ Flowers unknown. Fruits Oct., Jan., March. Altitude: 1 000-1 200 m.

NOTE: Juvenile plants may possess very large leaves, measuring 14-21 by 8-10 cm; they sometimes have shallowly depressed nerves on the upper surface.

4. *Nothofagus balansae* (Baill.) Steen.

J. Arn. Arb 35 : 266 (1954).

— *Trisyngyne balansae* BAILL., *Adansonias* 11 : 137 (1873); BAUMANN-BODENHEIM, Bull. Mus. Hist. Nat. Paris, ser. 2, 25 : 420 (1953).

— *N. sp.* DAWSON, *Tuatara* 14 : 6, fig. 1d (1966).

Tree, 6-12 m high, 22 cm diameter (once noted). Leaves coriaceous to thick-coriaceous, obovate to obovate-oblong, widest above the middle, narrowed to the base, with a rounded retuse apex, crenate along the margin in the upper half, 4 $\frac{1}{2}$ -8 by 2-4 cm; upper surface fine-tessellate veined

but not prominently so, ridge on midrib only in the lower third; on under surface the tessellate venation hardly prominent; nerves c. 10 pairs, not strongly prominent beneath, each nerve ending in a crenation; petiole short, c. 3-8 mm. ♂ Flowers in triads in pseudo-glomerules, the peduncle c. 5-10 mm; perianth sessile, c. 5-6 mm long. ♀ Flowers 3 per cupule. Cupule sessile, with 5-6 lamellae, the halves 15-20 by 12-17 mm. Nuts broad-ovate, with a narrow wing, 12-18 by 10-18 mm.

TYPE : *Balansa* 1377.

Route des Sources, à cote 570, *Corbasson* 217; ditto, à cote 500, *Corbasson* 216; Road to Mt des Sources, 600 m, *McKee* 2090; ditto, 500 m, *Abbe & Corbasson* 12200; ditto, 680 m, associated with *Agathis ovata*, *Rhodamnia*, *Xanthomyrtus*, *Casuarina* and *Cunonia*, *Ingle* 1.83; ditto, 650 m, near old sawmill, *McKee* 2090. — Kopéto, Crête est du mont Vert, 700 m, maquis haut sur pente raide rocheuse, péridotite, petit peuplement dans ravin, *McKee* 22202, 22203 (juv.). — S.E. Pic Buse, 500 m, *Baumann-Bodenheim* 1564, 16075; Contrefort du Me Maoya au-dessus de la mine Emma, 1350 m, forêt humide, *McKee* 12973 (coll. *Corbasson*); ditto, *McKee* 12974 (juv.). — Mt Paeoua, plateau sommital, 900-1100 m, arbre abondant en forêt humide d'*Araucaria-Nothofagus*, *McKee* 17039; ditto, 800-1000 m, fr. Febr., *McKee* 18401; ditto, sur terrain serpentineux, fr. Oct., *McKee* 17692. — Above Téné, near Bourail, *Balansa* 1377, ♂ fl. March. — Rivière Bleue, 300 m, *Baumann-Bodenheim* 15044; ditto, 2 arbres isolés à l'extrémité de la voie ferrée de la Forestière, fr. July, *Corbasson* 213.

ECOLOGICAL SUMMARY: Parent rock peridotite (once noted). ♂ Flowers March (once noted). Fruits Febr., June-July, Oct. Altitude: 300-1350 m.

NOTES: Two collections by CORBASSON are noteworthy in relation to *N. aequilateralis*, in having fairly narrow leaves and rather an elliptic shape; *Corbasson* 215 has moreover entire leaves, but is otherwise very similar to *Corbasson* 217 which has crenate upper leaf halves. By the deeply notched, stunted-rounded leaf apex they must, however, belong to *N. balansae*, to which GUILLAUMIN also referred them.

At high altitude small shrubs of this species may carry fully developed cupules and nuts (*McKee* 17692).

McKEE collected a seedling (*McKee* 12974) which possesses lanceolate, pointed leaves reminding in shape of *N. aequilateralis*, but because they are crenate in the upper half I believe he is correct associating them with *N. balansae*.

5. *Nothofagus discoidea* (B.-B.) Steen.

J. Am. Arb. 35 : 266 (1954).

— *Trisyngne discoidea* BAUMANN-BODENHEIM, Bull. Mus. Hist. Nat. Paris, ser. 2, 25 : 420 (1953).

Tree, 10-20 m. Leaves coriaceous, ovate-oblong, widest distinctly below the middle, narrowing towards an acutish apex, with crenate margin in the upper part, $7\frac{1}{2}$ - $12\frac{1}{2}$ by $2\frac{1}{2}$ -5 cm; upper surface not prominently fine-tessellately veined, under surface somewhat coarser tessellate and finely prominent; nerves 9-11 pairs, prominent beneath, ending in a crena-

tion, midrib not depressed, only with a ridge in the lower fourth; petiole 8-15 mm. ♂ Flowers unknown. ♀ Flowers solitary. Cupule almost sessile, with 6-8 lamellae, finely wide-gaping, woody, the halves 18-20 mm long and wide. Nuts roundish, 14-20 by 11-20 mm.

TYPE : *Baumann-Bodenheim 15000*.

Mois de Mai, *Baumann-Bodenheim 15000, 15001, 15109, 15114*. — Plaine du Lac, Forêt Électrique, remnant rainforest near head of small river valley, *Abbe & Lucien 10380*; ditto, 210 m, on serpentine, in 1954 regenerating after fires of 1925, young ♀ July, *Ingle 1.65*. — Unlocalized, *Service Forestier 208*, young fr. — Région du Bon Secours, forêt dense sur péridotites, 200-250 m, *M. Schmid 1131*; ditto, Baie des Pirogues, fr. June, *Corbasson 210*.

ECOLOGICAL SUMMARY of this rather rare species very insufficiently known: Parent rock serpentine or peridotite. ♂ Flowers unknown. Fruits June-July. Altitude: 200-250 m.

NOTES: Except for the spiral phyllotaxis sheets remind superficially distinctly of the New Guinean *N. perryi*, but the latter species has 3 nuts per cupule.

As usual in New Caledonian species leaves of seedling trees 1-2 m high are much larger than those of the mature trees, one collection having leaves measuring 17 by 5 ½ cm.

IDENTIFICATION LIST

- Abbe & Corbasson 12188* : 1; *12189* : 2; *12200* : 4; *12201* : 1.
Abbe & Lucien 10380 : 5.
Aubréville & Heine 149, 181 : 2.
Balansa 1377 : 4; *2749, 3557* : 2.
Baumann-Bodenheim 1564 : 4; *1642, 1743* : 2; *11243, 11277, 11295, 11703* : 3; *14843, 14907, 14908, 14910* : 2; *15000, 15001* : 5; *15044* : 4; *15109, 15114* : 5; *15273, 15275, 15276* : 1; *15596, 15600, 15606, 15626, 15628, 15700* : 3; *16073* : 2; *16075* : 4.
Bernardi 9340 : 2.
Blanchon 991 : 1; *1631* : 2 (coll. L. Lavoix).
Corbasson 210 : 5; *211* : 1; *212* : 2; *213* : 4; *215* : 1; *216, 217* : 4; *218* : 1; *219, 220* : 2, *221* : 1.
Dawson 107 : 3, *18/12/70* : 1.
Ingle 1.65 : 5; *1.79* : 1; *1.83* : 4.
Jaffré 349 : 1.
McKee 2090 : 4; *5339, 12406* : 2; *12973, 12974* : 4; *14530* : 1; *15981, 16689* : 2; *17039* : 4, *17327* : 1; *17571* : 2, *17692* : 4; *17968, 17969* : 2; *18401* : 4; *20104, 21086* : 2; *21595, 21618* : 1; *22202, 22203* : 4; *22869* : 1; *23061* : 2; *23126, 23127* : 1; *23129* : 2.
Schmid, M. 333 : 1; *1131* : 5; *2645* : 3.
Service Forestier 208 : 5.
Thorne 28685 : 2.
Veillon 958 : 2; *1920* : 1; *1955* : 2.

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